EUROPEAN COMMUNITY

COMPETITIVE AND SUSTAINABLE GROWTH PROGRAMME

SOURDINE II

D8-1
Implementation Plan

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Summary

This document contains the implementation plan for the Sourdine II project's Noise Abatement Procedures, which are described in detail in the D3.1-2 deliverable.

The implementation Plan will help the decision maker by clearly stating the constraints, the timeframe and the steps that have to be taken to introduce the procedures in the ATM system. It will also show that there is a trend in the procedures such that the preliminary most beneficial are the ones that have required more changes in the ATM system.

Since the implementation Plan has a general point of view tailoring to the current airport or country situation will have to be performed by the decision maker, responsible for coordinating all the changes and the actors influenced by the changes.

The timeframe for the Sourdine II procedures is 2015 but the steps towards the total implementation have no date since the time schedule for every change is dependant on the decision maker's objectives and choices.

The document has tackled the "when" (based on changes to the system), the "where" (based on the density of traffic thus the airport) and the "how" (reiterative stepped implementation). Mitigating solutions are described in the airports' implementation section and the regulatory requirements (further step after Sourdine II) have been summarised and partially tailored.

Dissemination of the results has also been introduced as the most efficient way towards making sure the knowledge is not lost at the end of the project and the Aviation industry is able to communicate to the public that commitment towards a better quality of life is supported and an environmentally friendly Air transport system is possible to achieve.

The implementation Plan should be used by the decision maker together with the balanced analysis to introduce the new NAP to the current system.

The Implementation path which considers the regulatory side of the Implementation has also been added to this document: the Implementation path is not specific of the SII procedures, it is a general cycle, while the regulatory side concerns the introduction of all the new procedures to the ATM system.

The general cycle drawn for the implementation of a new procedure reflects as required by ICAO and by the regulatory bodies.

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1. Introduction

1.1. Purpose

The following definition highlights the purpose of a general implementation Plan:

“The implementation Plan [ISB] document describes the steps necessary to turn the project's product or service over to the business unit and maintenance & operations support. The Plan assures that all of the necessary steps are identified and that each of these steps has the resources assigned to them. Sources of information for implementation Planning should include representation of all those who have assignments or who are affected by the project's outcomes.”

or

“Implementation occurs when an individual (or decision making unit) puts an innovation into use”. The issue becomes more complicated when we are addressing the implementation of the more abstract concept of a Plan [UIS]. This document includes the above points and will help the decision maker to determine the “Where?”, “How?” and “When?” Sourdine II procedures can be implemented to obtain the most noise reduction benefits.

1.2. Background

Operational procedures are one of four elements of ICAO’s balanced approach [IBA]:

1) Reduction at source
2) Operational procedures
3) Operating restrictions
4) Land use control

The Implementation Plan is the natural step forward for the Sourdine II procedures, by detailing their introduction, it achieves both the projection of the projects result on real life plus it bridges the gap between theory and real practice.

The document strongly relies on the inputs by the Expert Panel’s and the consortium experts in trying to identify the steps and the aspects which influence the procedures introduction.

1.3. Objective

The implementation plan document describes the steps necessary to turn the project's product or service over to the business unit and maintenance & operations support. The plan assures that all the necessary steps are identified and that each of these steps has the resources assigned to them. Sources of information for implementation Planning should include representation of all those who have assignments or who are affected by the project's outcomes.
The implementation plan is based upon analysing the constraints and solutions of the procedures, which gives us a preliminary time schedule, mitigated (shortened) by the location of the implementation (airports).
The Sourdine II implementation plan should be weighed as a preliminary Plan (and as a tool for the decision maker) to the introduction of the procedures, further steps are needed to close the loop, as well as extra tailoring for the local situation be it airport wise, country wise and European wise are needed.

1.4. Document Structure

This document consists of the following chapters:

1. Introduction: presents the purpose of the document, background, document structure, a glossary and the reference documents.
2. A brief description of the Sourdine **II** procedures.
3. The implementation time schedule dependant on system constraints (WHEN?).
4. Implementation to different size airports (WHERE?).
5. Proposed Sourdine **II** stepped implementation (HOW?).
6. Regulatory requirements when introducing new procedures.
7. Conclusions and steps forward.

1.5. Glossary

Term	**Description**
AMAN	Arrival MANager
APV	Approach Procedure with Vertical guidance
ADS	Automatic Dependant Surveillance (-Addressed-Broadcast-Contract)
ASAS	Automatic Separation Assurance System
ATOP	Advanced Technologies and Oceanic Procedures
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Services
CAA	Civil Aviation Authority
CBA	Cost Benefit Analysis
CDA	Continuous Descent Approach
CNS	Communication, Navigation, Surveillance
CTR	Controller or Control Zone
UPS	United Parcel Service
DM	Decision Maker
FMS	Flight Management System
FPA	Flight Path Angle
FTS	Fast Time Simulation
GBAS	Ground Based Augmentation System

GS	Guide-Slope
IAF	Initial Approach Fix
ICAO	International Civil Aviation Organisation
INM	Integrated Noise Model (developed by the FAA)
NADP	Noise Abatement Departure Procedure
NAP	Noise Abatement Procedure
NM	Nautical Mile
NPA	Non-Precision Approach
PA	Precision Approach
QFU	Runway in use
RNAV	Area Navigation
RTS	Real Time Simulation
RWY	Runway
SI	Study of Optimisation procedURes for Decreasing the Impact of NoisE
SID	Standard Instrument Departure
SII	Sourdine II Project
SML	Small-Medium-Large
SML term	Short-Medium-Long Term
SOURDINE II	Study of Optimisation procedURes for Decreasing the Impact of NoisE II
TMA	Terminal Manoeuvring Area
TMB	Technical Management Board (of Sourdine II)
TOD	Top Of Descend
WG	Wind Gradient
WP	Work Package

1.6. Reference Documents

LIST OF REFERENCE DOCUMENTS	
Short Reference	**Author / Organisation, Title, Edition, Date and Reference**
[TA]	SII Technical Annex
D2-1	Validation Methodology Report
D3-1-2	Detailed definition of new noise abatement procedures
D3.2	Requirements for tools
D4.1	Report on the global results; compilation of D4.1-1, D4.2-1 and D4.3-1
D4.2	Safety assessment of Sourdine II procedures
D6-1	ATC prototype results
D6-2	Prototyping results flight simulator
D6-3	RTS results
D10-1-4	SII April 2005 Workshop results
ECIP	European Convergence Implementation Plan (Executive summary)
ANCAT PLANO	European aviation workshop on Operational Noise Abatement Procedures, PROCEEDINGS, LUX , 14 – 16 December 2004.
ANERS	AIAA/AAAF Aircraft Noise and Emissions Reduction Symposium, Proceedings, Monterey, USA, 24-26 May 2005,
[IBA]	"*The "balanced approach" to aircraft noise management*" (Appendix C of Assembly Resolution A33-7), ICAO Assembly, 2001
[ISB]	Project Management Framework Planning – Implementation and Transition Plan, by the ISB http://isb.wa.gov/tools/pmframework/Planning/implementation .aspx
[UIS]	"*Understanding IS Strategy Implementation : A Process Theory Based Framework*" by C.E. Moe, H. Nilsen, T.U. Ørvik, Agder University College, Department of Information Systems Serviceboks 422 (2000)
[FAAs]	AOC 23-05 by the Federal Aviation Authority (FAA), June 23, 200504-02-2005
[GT]	"*Capacity Enhancements in IMC for Converging Configurations with Down-Link of Aircraft Expected Final Approach Speed)* A. D. Mundra and A. P. Smith, The MITRE Corporation, McLean, VA 20th DASC, Dayton Beach, Florida, in October 2001

2. Sourdine II Procedures

2.1. Cause for change and benefits

The need for NAPs is both a requirement by the communities surrounding airports and their representatives plus an important point of action included in ICAO's balanced approach for a more environmentally friendly aviation industry. A change on the operational side for landing and departure procedures is thus looked at with great interest being the most delicate but also perceived as the most invasive side of the air traffic which affects local residents.

The Sourdine II procedures have rightly proved in the project to be able to deliver this mitigation, not by redistributing or relocating but on actually decreasing noise values.

These benefits, better and quantitatively explained in D4-1 deliverable, have shown a trend in the procedures' noise benefit delivery; from procedure I to V for approaches and 1 to 3 in departures, there is an increment in the benefits they give. How much this increment is and in which order we should go from best to less best (in terms of noise and emissions) will not be part of the implementation plan rather of the balanced analysis.

2.2. Brief description

The Sourdine II procedures defined in detail in D3.1-2 are designed following and combining three major concepts and only describe the vertical operation:

<u>For Approaches</u>

- 'Variable thrust CDA': Thrust settings are adapted
- 'Variable vertical flight path CDA': The flight path is adapted
- 'Variable speed CDA': Fixing thrust profile and flight path results in a certain speed profile

They define a vertical or speed profile to which the following noise mitigating operations were combined:

- *Low Power /Low Drag (thrust idle or use of thrust as low as possible)*
- *Increased height profile and steep angles*

<u>For departures</u>

Using the following operational thrust operation definitions

- "Cutback Thrust"
- "Gradual thrust increase" [proposed in the previous Sourdine project]

Approaches	
I	Procedure I: Reference FMS procedure with level deceleration at 3000ft
II	Procedure II: Basic CDA with 2° initial FPA
III	Procedure III: CDA with 2° initial FPA and increase d final glide slope (4º)
IV	Procedure IV: CDA with constant speed, variable FPA segment at landing configuration
V	Procedure V: CDA with constant speed, variable FPA segment at intermediate configuration
Departures	
1	ICAO A
2	SII Optimised Close-in
3	SII Optimised Distant

All the procedures are based on the application in RNAV airspace (lateral flight path). This is one of the assumptions made in all the simulations and assessments done (FTS, RTS, etc.).

2.2.1. Approach Procedures

Brief description of approach procedures:

Procedure I: Baseline FMS approach procedure: This procedure has a standard vertical flight path, with a level segment at 3000ft, during this last part of the flight path deceleration is performed, making this procedure quite competitive and better than standard approach procedures.

Procedure II: Basic CDA with 2º initial FPA: this procedure follows a fixed 2-degrees path angle from 7000ft up to ILS intercept at 3000ft.The aircraft decelerates at idle thrust in clean configuration during this part of the flight, deploying the cleanest possible landing configuration on landing.

Procedure III: Basic CDA with 2º initial FPA and increased final glideslope: the difference between procedure II and procedure III is the steeper flight path angle (4º instead of 3º for all other approach procedures) on the ILS.

Procedure IV: CDA with constant speed, variable FPA segment at landing configuration: the procedure is largely flown, from 7000ft to ILS intercept, with idle thrust and in landing configuration.

Procedure V: CDA with constant speed, variable FPA segment at intermediate configuration: the procedure is similar to procedure nº IV, with the difference that the variable FP is the result of an idle thrust descent from 7000ft to ILS intercept on an intermediate configuration.

2.2.2. Departure Procedures

Procedure 1: Baseline take-off procedure: this is the baseline departure procedure (NAP ICAO-A)

Procedure 2: Sourdine optimised close-in: this is the close–in departure procedure, for which the noise relief is located relatively close to the runway. The procedure is distinguished by a deep cutback in thrust , followed by a gradual increase in thrust starting at 3000ft [D3-1-2].

Procedure 3: Sourdine optimised distant: this is the distant departure procedure, same as for the previous one with the difference that the noise relief is further away from the runway. Again the procedure is distinguished by a deep cutback in thrust but on reaching zero flap speed (Vzf), followed by a gradual thrust increase starting at 5000ft [D3-1-2].

3. The actors

In the definition of a new ATM operational concept all the parties involved in its implementation represent the stakeholders to be identified. Stakeholders' expectations concerning a particular ATM problem are the driving factor of the operational concept objectives [D2-1]. ATM is a complex system involving different services, organizations, sub-systems and users, therefore the global objective of a new concept has to respect each actor interests regarding of its role. In the specific context of Sourdine II, the following stakeholders have been identified, each one with its role and its main needs:

- **Community**: Due to the specific nature of the problem investigated by Sourdine II, people resident in the airports' surrounding may be considered as one of the main stakeholders.

  Interests of this category coincide with Sourdine II main objectives: to reduce noise and emission levels.

- **Airspace Users**: Within this category, Airlines, General Aviation and Air Force are identified.

  The objectives are to:

  - reduce flight time and fuel consumption through flight efficiency and system flexibility
  - minimize delays
  - reduce pilot workload
  - improve safety (or, at least, maintain current levels).

  Airspace users often actors of the "demand pull"[1]are mainly interested on the economic aspects of the new operational concept, but safety is still a primary issue. In the specific context, flight efficiency is well linked with environmental issues. Flexibility and national security remain prevailing matters for the Air Force.

- **Air Traffic Services Providers**: Taking into account the approach taken by the Sourdine II project, the main actors involved are the Air Traffic Control Service Providers and, more specifically, the Approach Control Centres and Tower/Ground units.

  The main interests are to maintain capacity and safety.

- **Airports**: In relation with the approach taken by the S-II project, airport authorities have a special interest in capacity. For this reason the main objective is maintaining capacity levels unchanged or, whenever possible, improved, taking account of safety matters. They are also interested in noise and emission reduction (for a better and more flexible operation).

- **Regulators**: National and international authorities are invested by the regulatory role.

  Due to their institutional roles, they are interested on the consistency of the operational concept with existing rules of evaluation and on the certification of new systems and

[1] technology development that is driven by user needs and requirements (demand), rather than by ideas or capabilities created by the development organization.

procedures, mainly in terms of safety, which has the highest priority for the regulatory bodies. There is also interest in reducing aircraft noise and emissions since regulation about these issues also exist.

- **Aerospace Manufacturers:** producing the aircraft, ATM/ATC, and airport facilities and equipment; often the source and actors of the technological push[2].

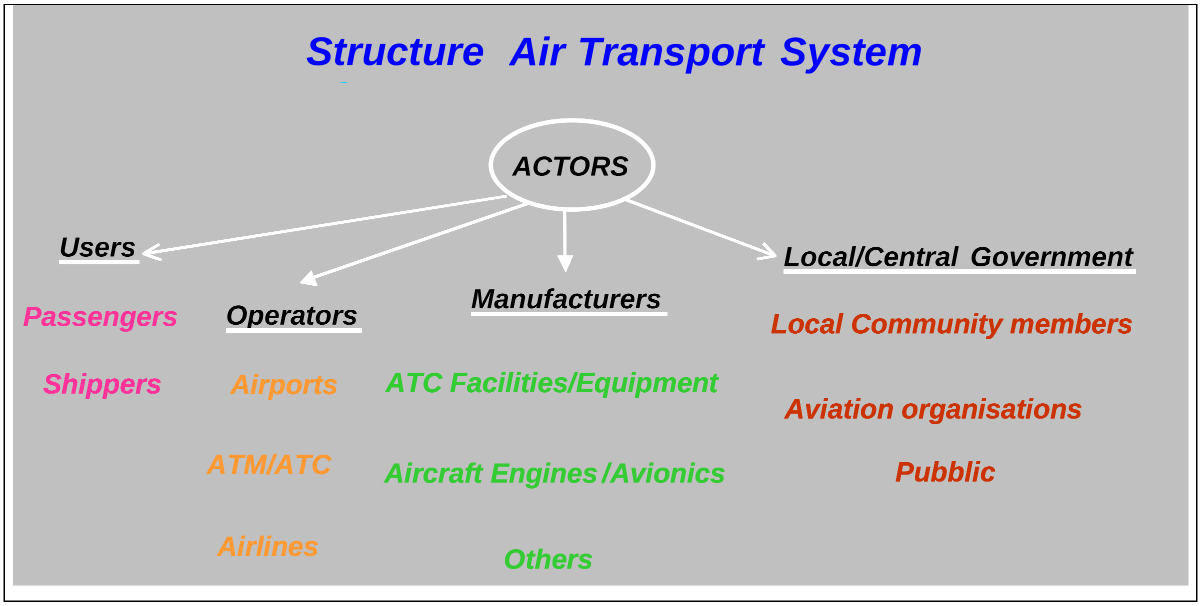

Image 1: Actors/Stakeholders of the Air Transport System

[2] technology development that is driven by ideas or capabilities created by the development organization in the absence of any specific need that customers may have. In technology push situations, innovations are created and then appropriate applications or user populations are sought that fit the innovation.

4. Procedure constraints impacting on capacity and safety (WHEN?)

The Sourdine II procedures, when implemented, will influence, in different ways and totally or partially the ATM system with its stakeholders.

The following section will try to show the main constraints the current system has shown towards the introduction of the procedures, beginning with:

- what affects the procedure?
- who the procedure affects directly?
- which domain does it affect-the solutions SII proposes?

The decision maker will be able, by going through the matrix, clearly pinpointing what she/he needs to do and where she/he needs to apply the change: the timeframe will be the result of the decision maker's decision to apply those changes.

The image below describes the way the time schedule for the procedures' implementation is determined by the introduction of the solutions.

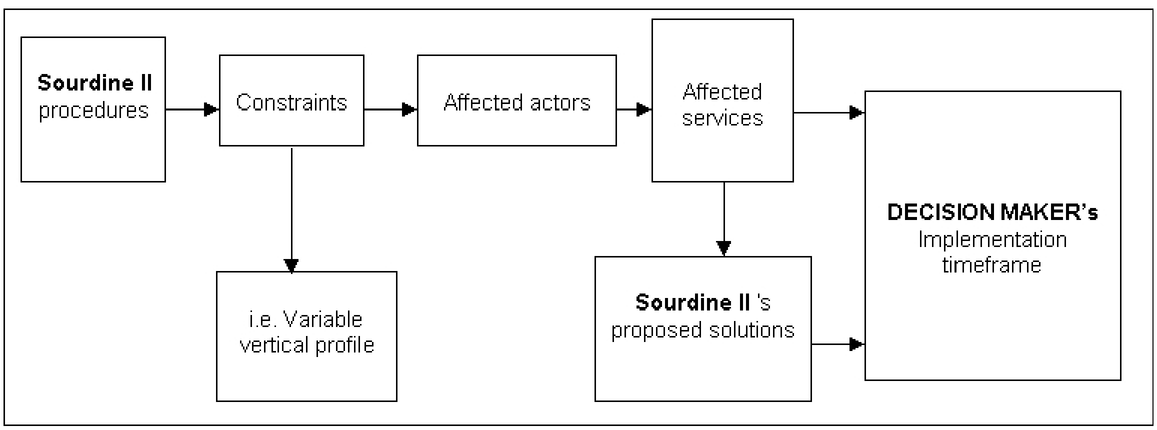

Image 2: Analysis of constrain affecting implementation time-schedule

The constraints impact the time-schedule for the introduction of the procedures while the solutions mitigate the time parameter or the "WHEN?". The above image shows the analysis made in the project aiming to outline the most appropriate options for implementing initiatives, identified and ranked in order of complexity by the SII project.

4.1. Constraints and solutions

Before getting into detail, procedure by procedure, on the constraints they suppose to the ATM system and the SII solutions proposed to mitigate them, we need to introduce those common external factors which generally affect the procedures.

Bearing in mind that Procedure nº1 is currently used in many airports and was chosen as baseline. It is assumed that ATM stakeholders accept this procedure without any change or problem.

4.1.1. General External Factors (constraining the SII procedures)

The mentioned external factors are the following:

1. Weather
2. Airport Layout (Specifically parallel RWYs)
3. Airspace design
4. Mixed equipage and
5. Mixed operations.

The above affect capacity, safety and environmental domain (non optimal execution of the procedure). For this section will refer only to the two first ones.

Weather

In general, weather will affect Sourdine II approach procedures as well as to current procedures, it is fairly understood that in case of safety margins being eroded by weather, the operators will revert to standard procedures. This is most valid for the departure procedures which apply a cutback, early in the departure. But also on those procedures which are more sensitive to tailwind (proc. IV, V) [D6-3].

The Sourdine II procedures are all based on the use of FMS to calculate the vertical flight path for the procedures (a current FMS was used in RTS). The encounter of wind gradients from different directions, not included in the wind model of the FMS, significantly influenced the Pilots' workload and the application of spoilers to loose velocity.

Airport layout

Close spaced parallel runways and /or the need for 1000ft of vertical distance between approaching aircraft or aircraft merging to final approach on parallel runways, highlighted the need for further safety nets which may alert the ATC of possible separation breaches or deviation on the lateral flight path.

Mixed equipage

The mix of airborne tools will affect both departures and approaches; but the greatest influence will be on the optimal execution of the procedures and on the repeatability of the procedures' (different speed profiles case which is already intrinsic when managing different aircraft models).

It is obviously an important factor to take into account in any potential operations transition, in order to assure the appropriate fleet equipage, certification and training. There is also need to guarantee the overall aircraft equipage with new capabilities before any potential removal of current procedures. So, it is not only important to consider the equipage need itself, but also it is essential to agree at Regional level a transition Plan, with advance annunciation of new procedures intention, giving time to users to appropriate retrofit their avionics and prepare the certification and training for the new procedures. So, it is a clear ANSP need to maintain, as much as possible, a clear interface feed-back with airspace users in order to get clear inputs from their needs and prepare, in consequence, the best techniques and procedures for obtaining the most productive benefits for both parts (see later sec.7).

Mixed Operations

The introduction of new procedures, as the Sourdine II, will be mostly in parallel with current procedures, making sure that transition does not negatively affect the airport and the ATM system. The mixture of both is not recommended, but the use of both, as currently in Schiphol, with different hours and runways allocated is possible[3] (further work should be performed on this case, which was not completely assessed by the Sourdine II project).

4.1.2. Specific Constraints

Some of the greatest constraints belonging to the SII procedures are:

1) ATC should not modify trajectories of the aircraft after the TOD
2) Different speed profiles for different aircraft.
3) Variation in the TOD point for variable flight path CDAs

These three constraints have a great impact on ATC.

The first specifies a change in the ATCos tasks: the importance of increasing the monitoring and using instructions only when it is absolutely necessary, the need for strategic aircraft flow management rather than tactical ahead of the TMA.

The second constraint introducing more speed variability to the traffic flow resulting in the need for better sequencing and merging of traffic before the TOD.

The third constraint introducing further variability in the TOD or the point where the CDA procedure is initiated.

The three constraints above clearly highlight the fact that the separation and the sequencing of traffic needs to be done before the IAF and in those cases where the segment between the TMA entrance point and the RNAV IAF point is not enough to sequence, before the TMA entry point

All the problems and solutions have been identified and tackled with in the D3.2 “requirements for tools deliverable”, the D4.2 safety analysis and have been tested through RTS , the results available in the D6-3 deliverable..

Based on these constraints the Sourdine II project has investigated the possible solutions which can mitigate the introduction of the procedures.

As stated before these specify the “WHEN?” or otherwise the establishment of an implementation time-schedule, a final timeframe thus separating the procedures into their Short-Medium-Long-term implementation aspect.

It must be understood that this is only the first step in the evaluation of the implementation time schedule, as the time variable also depends the traffic density, which will be discussed later.

3 The possibility of having a standard approach to parallel RWYs with a CDA, is actually a safety mitigation possibility in order to keep the flights at 1000ft vertical distance from each other.

4.2. Sourdine II Procedures

The following matrices show the stakeholders' needs for each procedure, basically what should be in place to have the optimal operation of the approach procedures. Each actor will assign (or will be pushed to assign) its known time schedule for each point, the result of this will be the timeframe: the result the decision maker will need to know and fix in order to prospect the introduction of the procedure into the ATM system (template Appendix A).

Procedure II	Stakeholder affected	Tools	Operational Mitigation	TIMESCHED.
	Airlines - Pilots will need to be trained	Enhanced Avionics Possible FMS Enhancement for WG adjustment Flight Configuration change cues	Speed Constraints (for repeatability and control)	?
	ANSP - ATC will need to be trained	New ATC[4] tools (Safety nets for parallel approaches) AMAN	Speed Constraints (for repeatability and control)	?
	Regulatory body Certification, standardisation			?
	Manufacturers	FMS wind gradient enhancement AMAN		?

DECISION MAKER **_TIME-FRAME_**

Table 1: Matrix of constraints timeframe implementation estimation (supports in the DM's choices).

[4] Among the SII ATC tools "ghosting " has been tested, the tool is already in use routinely in Canada by NAVCANADA as CRDA (Converging Runway Display Aid). The SII project expanded its use to the whole TMA and applied it to the merging of traffic on the RNAV routes.

The above is applicable to all the subsequent tables delivering the Implementation time estimation of each procedure.

4.2.1. Arrival procedures

Procedure III	Stakeholder affected	Tools	Operational	TIMESCHED.
	Airlines - Pilots will need to be trained	Avionics for 4ºGS Enhanced Avionics	Speed Constraints (for repeatability and control)	
	ANSP - ATC will need to be trained, change	New ATC tools (Safety nets for parallel approaches)	Speed Constraints (for repeatability and control) (on CDA FP)	
	Regulatory body Certification, standardisation		Airspace re-design for TMA	
	Manufacturers	(4ºGS) Auto land system modifications		
	Airport	Change the ILS GS or opt for another technology	Missed approach change	

Procedure IV	Stakeholder affected	Tools	Operational	TIMESCHED.
	Airlines - Pilots will need to be trained	Enhanced avionics with solutions proposed by SII	Frequent maintenance turnaround Maintain separation	
	ANSP - ATC will need to be trained, change	New ATC tools (Safety nets for parallel approaches)	Change from control to monitoring (on CDA FP)	
	Regulatory body Certification, standardisation		Airspace re-design Certification of non standard full landing gear operation from ToD	

	Manufacturers	Fatigue analysis FMS enhancements	Higher maintenance costs	
	Airport	Monitoring for parallel RWYs	Missed approach change	

Procedure V	Stakeholder affected	Tools	Operational	TIMESCHED.
	Airlines - Pilots will need to be trained	Enhanced avionics with solutions proposed by SII	Maintain separation	
	ANSP - ATC will need to be trained, change	New ATC tools (Safety nets for parallel approaches)	Change from control to monitoring (on CDA FP)	
	Regulatory body Certification, standardisation		Airspace re-design	
	Manufacturers	FMS enhancements		
	Airport	Monitoring for parallel RWYs	Missed approach change	

4.2.2. Departure Procedures

Dep. procedure I	Stakeholder affected	Tools	Operational	TIMESCHED.
	Airlines - Pilots will need to be trained	Departure included in FMS Enhanced Thrust control	Update flight manual	
	ANSP - ATC will need to be trained			
	Regulatory body Certification, standardisation		Update operations and obstacle clearance study	

Dep. procedure I	Stakeholder affected	Tools	Operational	TIMESCHED.
	Manufacturers	Improved FMS algorithms for departure and thrust control		
	Airport		Tailored departure	

Dep. Procedure II	Stakeholder affected	Tools	Operational	TIMESCHED.
	Airlines - Pilots will need to be trained	Departure included in FMS Enhanced Thrust control solutions proposed by SII	Update flight manual	
	ANSP - ATC will need to be trained			
	Regulatory body Certification, standardisation		Update operations and obstacle clearance study	
	Manufacturers	Improved FMS algorithms for departure and thrust control		
	Airport		Tailored departure	

The Sourdine departures, assessed in the Sourdine II project, reflect the fact that they can be currently implemented and enhanced with a few tools necessary for the pilot to improve performance of the procedure.

4.3. Results

In conclusion the above matrices are a tool in the hands of the DM (decision Maker) to make more clear where the need for change is located, were coordination is needed and what time prospects will he have in hand. The TIME column is the direct result of the analysis made for each procedure.

From this tabular analysis and building up on all the information gathered along all the Sourdine II project [Sourdine II, Sourdine, etc..], as well as feedbacks from ATM stakeholder representatives during various events: workshops, expert panels, etc.. organized by the SII consortium and the participation to international symposiums [ANCAT, ANERS, etc..] were alternative operational practices were discussed, we arrive to the result summarized in the image below.

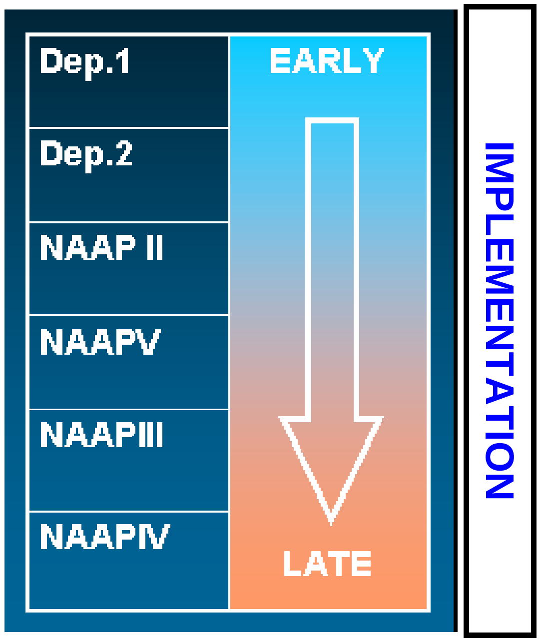

Image 3: Specific Sourdine II procedure time schedule for full implementation

Image 3: shows the implementation trend for the Sourdine II procedures, from the most simple to the most complicated (procedures are ranked on estimated implementation time).

The estimation is based as stated earlier mostly on the work performed during the whole project (see specific deliverables for further information) and the feedback from the workshops [i.e. D10-1-4], in which current ATM representatives gave us an estimation dependant on what was shown in the matrices of the time-schedule.

5. Airport Implementation (WHERE?)

From the previous section the method is obtained to calculate the necessary time the actors will need to implement the solutions for the implementation of the procedures, and the decision maker to introduce them in the ATM system, but bare in mind that the constraints identified there are specially dependant on high traffic density.

The repeatability of the procedures (i.e. see 4.2 Proc. IV) thus the predictability for both Pilots and ATCo; further changes in ATC tasks (for which training is required); new avionics and equipage: all these aspects get more complicated with the density of the traffic flow, the higher the traffic the more changes need to be applied to the system.

As such the best way to create a Plan (as a sequence of steps towards full implementation) is to transpose the above by taking into account that the procedures will be implemented in a TMA and that the sizes of the airports which reflect the traffic density also reflect the capacity and the safety constraints, hence they can be used to amalgamate the implementation steps.

In the Sourdine II project one of the most important points was the application of the procedures to three different airports, which belong to the small, medium and large category. The implementation steps will be different depending on the site. The result is a variation in the timeframe and the possibility to make trials and further improve implementation.

5.1. Airport definition

The specific airports described in Sourdine II can be into three categories: large (Schiphol, Charles de Gaulle, Madrid), medium and small (Naples).

Thus three generic airports have been identified: small, medium and large. The features characterizing each generic airport can be divided into four categories:

- layout (number and type of runways)
- traffic (the kind of traffic using the airport)
- procedures and airspace structure associated to the airport
- ATC services available on the airport.

The following table summarises the main characteristics associated to each generic airport category.

	Small airports	Medium airports	Large airports
Layout	Only one concrete	Usually, only one concrete	Usually, more than one concrete runway
Traffic	90% VFR - 10% IFR	80% IFR - 20% VFR	In principle, only IFR
	No capacity problems	Distribution not even along day	Operated with declared capacity
	Usually domestic flights	Domestic and international flights	Domestic and international flights
	Cat A, B anc C aircraft	Cat A, B and C aircraft. D possible	Any category of aircraft
	Accessible to IFR flights	Accessible to VFR flights	
Procedures /Airspace	Generally IFR approach procedures based on NPA	Usually, ILS available only on one QFU	Normally, NPA and PA available on several QFU's
	Basic airspace	NPA procedures on other QFU	Usually CAT-III procedures implemented on several QFU's
	Class D CTR	Usually, a CTR and a TMA	Runway schemes to balance environmental impact
	Usually quite high minima		Complex airspace structure
			A TMA with one or more CTRs
			Associated airports
Air traffic control	Very limited ATC services	Limited ATC services	Full radar service available
	No ATC aiding tools	Generally radar services available	Controller tools available

Table 2: Main characteristics of generic airports

Usually, there are large urban areas in the vicinity of large airports increasing the environmental impact and the sensitivity to noise and emission pollution; on the other hand due to the ever expanding "No Frills" airline market which points to medium and small airports, noise and emission problems could be the new constraints for their growth.

5.2. Airport Analysis (SII procedures)

By analysing the above table and comparing it with the needs from each procedure, the following conclusions can be made:

"*The time frame for the application of the Sourdine II procedures can be reduced depending on the scale of the airports we introduce them in*".

i.e. Procedure nº II	Procedure related problems	IMPACT			Mitigating solutions
		Small Airport	Medium Airport	Large Airport	
	layout (number and type of runways)	Does not affect the procedure's implementation	Could affect if more than one RWY	Affects Parallel RWYs operation	Optimised RWY use for large
	traffic (the kind of traffic using the airport)	Low traffic density no need for sequencing	Could affect seasonal or peak	Affected by loss of capacity	Time schedule: night, out of peak hours

i.e. Procedure nº II	Procedure related problems	IMPACT			Mitigating solutions
		Small Airport	Medium Airport	Large Airport	
		and merging	hours		
	procedures and airspace structure associated to the airport	No need to change the airspace due to new procedures	Small changes	Redesign of airspace	Further analysis needed
	ATC services available on the airport.	ATC service very limited, no need for ATC tools	May need new ATC tools	Need for new ATC tools	Training
Airlines (pilots)	Realizing the procedure optimally	Conventional FMS (Flight Management System) guidance works well for these conditions	Use of enhanced avionics (WG)	New Pilot tools	Training

Table 3: Impact of airport size on Procedure constraints

The scale on which the procedures affect the airports characteristics will be further detailed by the balanced analysis, but qualitatively we now find that:

“excluding Procedure IV since this procedure was not accepted by the users (pilots and controllers due to several reasons both technical and operational [see sec.5.4 in D6-3], all the others can be positioned on the above table: an implementation trend can thus be identified for the WHEN case in the previous section”.

Relating to procedure IV it is otherwise true that nowadays large aircraft use the landing gear to reduce velocity: landing gear is used to reduce the increase of velocity once the GS has been intercepted but not from ToD, the longer periods with full landing configuration may also lead to structural fatigue and higher maintenance costs [D4-3].

Small Airports

The Sourdine II approach procedures could all be implemented in small airports due to small traffic density, the only constraint for procedure IV and V the fact that enhanced airborne avionics would be necessary, while for procedure III the 4º descent could lead to the use of an APV[5] type of landing (since no ILS is available and for better accessibility in difficult weather conditions or terrain).

- Implementation could start short term.
- Use of APV procedures for high GS approaches.
- No restriction on hour of operations.

An APV type of approach does not depend on ground vertical guidance, since their would not be the requirement to stick to the 3º ILS GS (see Table 2:) but does provide the necessary vertical guidance.

Medium Airports

In medium airports with medium density traffic, controller tools will be needed to keep the capacity-value, mostly during those seasonal periods with the most density. On the other hand mitigating solutions could be introduced as the spreading of these traffic peaks along all the operative day[6] or the use of the procedures during out of peak hours and at night time.

The arguments regarding the pilots' tools side do apply here as well. But Procedure III is the only procedure which would have a PA landing system constrain, as changes in ILS are not at all foreseeable, on the other hand an APV procedure is, in the short to medium term foreseeable.

Large Airports

Large airports, in order to maintain the current capacity will follow a stepped implementation of the procedures, introducing the one which less imposes changes on the ATM system to move to the one which does (and gives better environmental benefits). Thus Procedure II could be implementable in the short-term, followed by procedure V and III which do impose greater changes.
High density traffic requires flight deck, controller and cockpit tools with advanced guidance.
Procedures need to be adapted to all aircraft types in order to make them fly optimal CDAs with a significant further noise reduction to be expected. One of the challenges is to define procedures that can be used by flight crew with no significant change in workload and to find ways to maintain minimum separation of aircraft.

An operational mitigating solution is the introduction of the procedures at night time to move on to off peak hours once the maturity of the procedures and of the system are provided.

On the economical side further improvement of the ground equipment and training will be acceptable for large airports which have an interest in modernising their installations and gaining environmental benefits on top.

[5] Approach with Vertical Guidance (APV). An instrument approach based on a navigation system that is not required to meet the precision approach standards of ICAO Annex 10 but provides course and glidepath deviation information. For example, Baro-VNAV, LDA with glidepath, LNAV/VNAV, and LPV are APV approaches.
[6] Traffic peaks are market driven and not made by the airport or aircraft operator

Departure procedures for Airports

Departure procedures will only be affected by obstacle clearance requirements and Pilot thrust management tools (gradual increase/cutback): the first is airport topographic specific, while the second is technological.

Resulting table

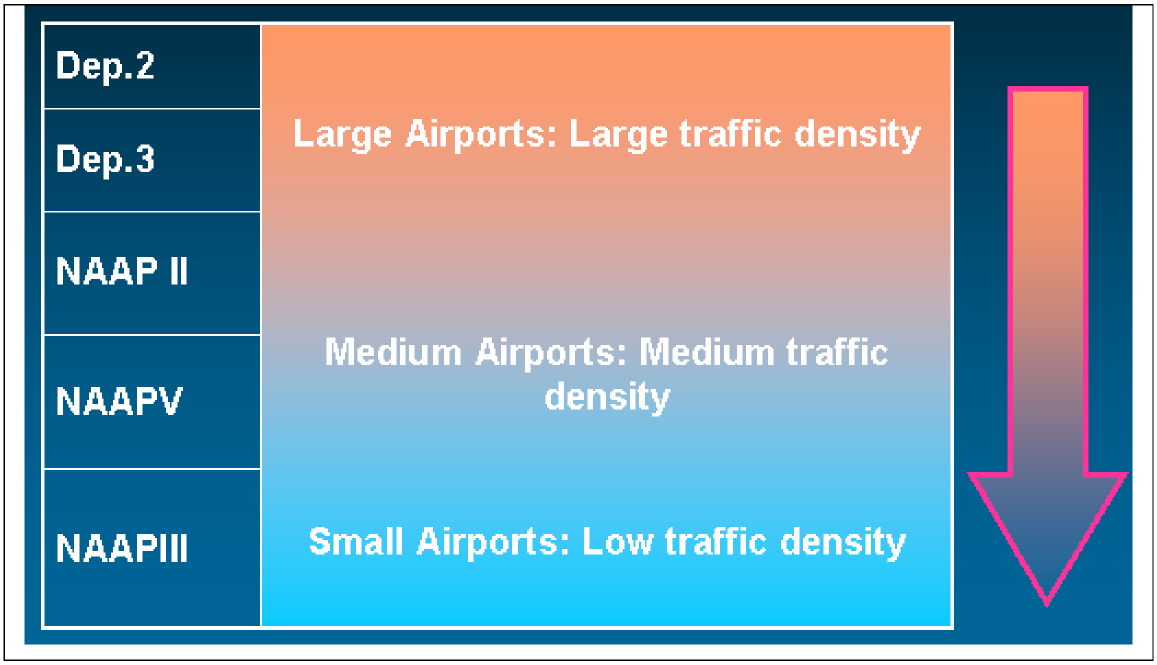

Table 4: Application of the Sourdine II procedures to different size airports

Ranked upon influence of traffic density: the arrow indicates that the top procedures can also be applied downwards (to small airports)

6. Sourdine II Implementation Plan (HOW?)

This section is the result of merging the "When?" and the "Where?": the when was taken into account as the primary imposition further mitigated by the where.

Here we suggest the implementation steps "How?", to be followed in order to introduce the new Sourdine II noise abatement procedures.

The cycle is an iterative loop which aims to build up experience while in parallel taking into account that solutions are deployed for the high traffic density case.

The following steps should be tailored to the specific current situation.

Step 1

- Introduce the CDA's which are less intrusive in dense traffic at night time
- Introduce the CDA's which do not need enhanced ATC tools and pilots tools into medium traffic during off peak hours and night time
- Introduce CDA's which can fully use the current technology into small airports during all day.

Step 2

- Analyse the situations for Step 1 and build up on experience from small to medium to large density traffic in order to improve the introduction of more conflictive procedures.

Step 3

- Check that the deployment phases for ground and airborne improvement accept the migration to higher density traffic of those procedures which give the more benefits, pass to a higher level of use thus go from step 3 to 2 to 1.

Step 4

Continue research and improvement, discarding procedures which are not beneficial.

Bare in mind that the systems or improvements the SII procedures need are not beneficial only for their own deployment, the benefits of these systems are widespread to all the parts of the ATM. Three clear examples are the Ghosting tool[7] with which ATCos manage the merging of traffic to the same point on a RNAV route, whatever type of procedures are used; the vertical navigation display, regarded as very useful by the users (Pilots) in delivering navigational awareness independent of the procedure used [see D6-1 & D6-3 for further details]; and last but not least the Datalink, on which systems and services like the Airborne

[7] "Ghosting" is based on the Converging Runway Display Aid (CRDA). CAASD developed CRDA for the FAA and licensed it to NavCanada. CRDA is being used in Calgary, and NavCanada is planning to expand its use to Toronto. In the United States, CRDA is used in terminal areas in Philadelphia and St. Louis. A controller display tool used in performing the staggering required for the converging runway operations. It has two modes of operation called "stagger" and "tie". In the stagger mode, a reference target (called the "ghost" target) is displayed at a reference location with respect to which controllers must space the real aircraft. (see Feldman, 1992 and FAA, 1994)[GT].

Separation Assurance System (ASAS)[8], Automatic Dependant Surveillance (ADS-A-B-C)[9], etc. are based, already enhancing the ATM's CNS domain.
The reader should be aware that the implementation Plan's steps should be evaluated towards the outcome of the balanced analysis, where the procedures are weighted for their benefits and the CBA.

The stepped implementation is valid either for the introduction of one procedure (if that is the case or choice) or different procedures: there may be a migration from one un-optimal procedure to an optimised procedure or a stepped migration from one procedure i.e. Procedure II to a further more noise beneficial procedure Proc III.

[8] "SafeRoute": UPS is expected to start flight tests (2006) of this system that will enable pilots to monitor spacing between aircraft during approaches and to guard against RWY incursions on the ground. The SafeRoute system is a series of automatic dependant surveillance-broadcast (ADS-B) software applications that are designed to enhance situational awareness through two main sub functions: surface area movement management (SAMM) and the "merging and spacing" feature.

[9] "ATOP": an air traffic system that allows controllers to reduce space between aircraft over U.S. oceanic air space is now fully operational at its first site—the New York Air Route Traffic Control Center. It will use ADS-A (automatic dependent surveillance addressed position report messages) and CPDLC (controller-pilot datalink communications) along with RNP (required navigation performance) capability to reduce aircraft spacing requirements to increase airspace capacity and efficiency.

7. Regulatory aspects (a step beyond)

Further to the Sourdine II implementation plan, the introduction of new procedures will need to comply with the following required path towards full implementation into the real world.

In general, implementation may follow two paths depending on complexity and number of changes involved in the ATM system:

1. <u>"Short Path" which also may stand for short-term application</u>
2. <u>"Long Path" which may also stand for long-term application</u>

<u>"Short Path"</u>

The first path which is the shortest is based on the fact that the operational procedures do give benefits and are readily applicable (follow the PANS_OPS, etc), i.e. the airline, based on previous design studies, evaluates the procedure both in the simulator and then in flight tests, training is given to pilots and results are then analysed. The positive outcome of the tests are then sent for the safety assessment (SA) to the ANSP which will then search for approval by the Local regulatory bodies (CAA, DGAC, ENAC, etc..) depending on the country the regulatory bodies may change. Once the SA is approved the airline is then given permission to fly the procedure, updating all the necessary manuals and operational aspects which are influenced by the new procedure.

This would be the most likely scenario for the SII departure procedures and the less demanding arrival procedures.

<u>"Long Path"</u>

The second path or case is when the introduction of the new procedures requires deep changes to the whole ATM system as: airspace redesign, new ATC/pilot tools, change in the operational tasks (i.e. ATC monitoring versus active control), etc.. Being more complex and involving all the actors, the implementation process would be longer and more complex.

This was seen as the most probable case for the SII arrival procedures, where the changes involved all the ATM stakeholders. Great emphasis was in fact given to making sure the actors were well informed and brought in to the implementation as early as possible, in order to make room for flexibility.

Once the choice is made to use the Sourdine II procedures the following steps should be taken by the decision maker to confirm the implementation to the regulatory requirements covering the introduction of new procedures.

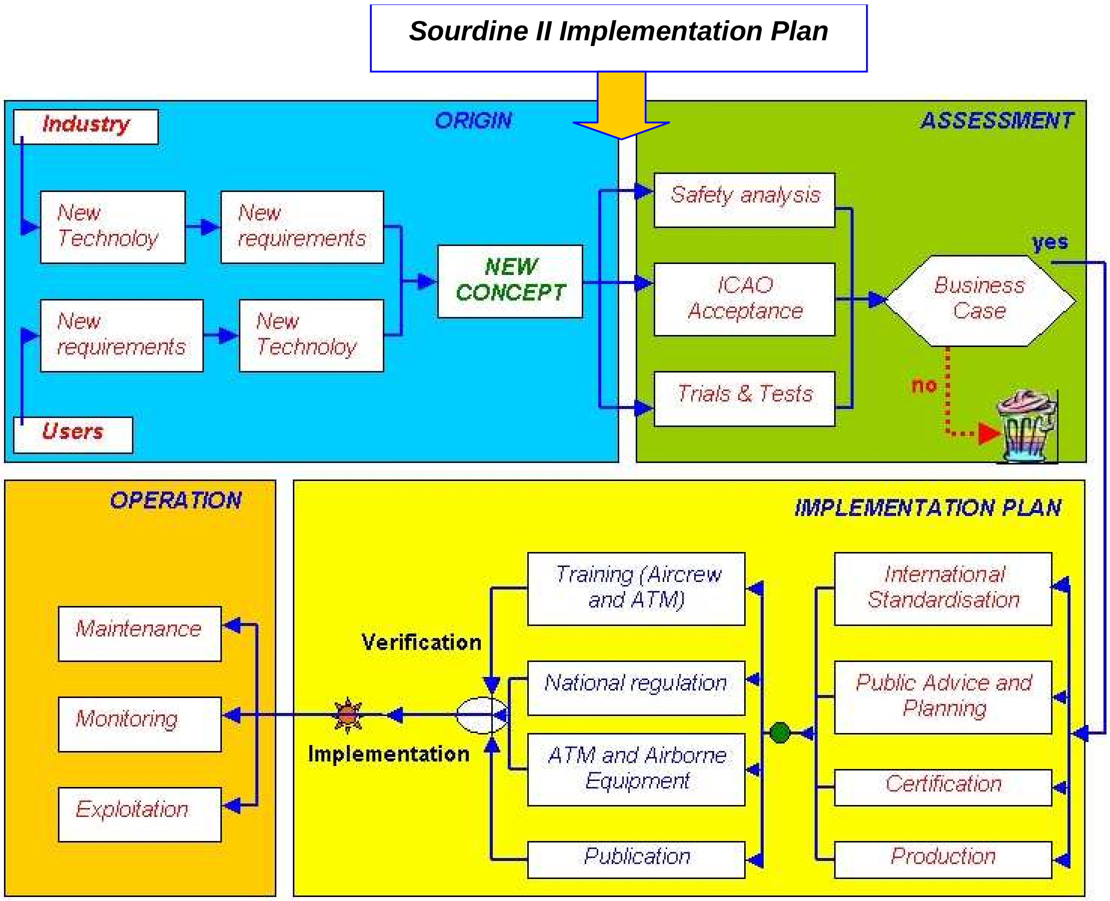

Image 4: General Implementation "Cycle of a Concept"

7.1. Implementation of a new procedure based on RNAV in the TMA

When a country's authority or airport are considering the introduction of new procedures based on RNAV in the TMA, the following points are required to be fully discussed and documented:

1. Identification of benefits and drawbacks on the operational aspect which influence the users and the service providers
2. A CBA taking into account the local situation when introducing the procedures must be done both by the aircraft operators and the ANSPs.
3. Certification by both the aircraft operators and the ATS providers for the use of these operations must be sought for where necessary, including the update of those practical aspects which influence the training of both ATC and crews during operations.
4. The Sourdine II "Safety Assessment" should be taken as the first step towards the preparation of the "Safety Case" which each ANSP concerned with the local implementation of the procedures, should produce following the standards dictated

by EUROCONTROL. The Member States should demonstrate they have considered all the aspects and taken all the necessary actions to make sure the operation fulfils the necessary safety levels.

5 Improvements for onboard equipment

6 Revise the means necessary to support the a/c which cannot comply with the NAPs requirements (allocation of contingency Plans, ATC is able of distinguishing capable a/c from non capable.

7 Technical requirements for airspace design following the current and improved future regulations.

8 Identification of requirements for new ATC tools

9 Consider if changes are necessary in the navigational infrastructure, possible contingency Plans in case a fault in the system occurs. In addition, Service Providers need to assure a smooth transition to any potential migration to new navigation capabilities, in order to maintain the Service Provision for all the potential users in the National Airspace. This kind of transition need to be improved with common agreements and strategies through ECAC Bodies, in order to assure a ECAC shamelessness and harmonization of local strategies at Regional or worldwide level.

10 Take care of the impact on ATC and ATM procedures' which are influenced:

- Change in SIDs and STARs
- Changes in Airspace configuration

11 Consult the aviation authorities, user groups and local organisations (environment, ICAO, EUROCONTROL). This point has already been covered by the workshop from which the two paths to implementation were explained.

12 The Business case, the aim of the business case should be to justify the implementation of the NAP in the TMA

13 To develop an implementation calendar. Experience shows that the introduction of new procedures should be gradual or along an adequate long period. Changes in ATM procedures and the necessity for training are against prefixed dates of change. Thus the Authorities need to publish an implementation calendar in order to inform the affected parts for them to obtain conform to the requirements. Implementation calendars have a local characteristic.

14 At a European level the local implementation Plan will be supported by the ECIP, the common medium term implementation Plan for ATM. Managed by EUROCONTROL on behalf of the participating individual states. Individual states are responsible for co-ordinating national actions with their own stakeholder groups [ECIP executive summary]. The ECIP sets out the operational, technical and institutional improvements that have to be applied to meet clearly defined performance requirements in certain key ATM performance areas,: safety, capacity, cost-effectiveness and the environment. It does this in terms of implementation objectives that describe the type of change to be applied. It then brakes down each of these objectives into a number of stakeholder lines of action, which describe the work that has to be completed by each of the stakeholder groups involved and when. The Sourdine II implementation Plan respects and relies on the future developments outlined in the ECIP Executive Summary.

15 <u>Design, Validation and publication of the new procedures.</u>

- Once the calendar is approved, the procedures should be drawn together with the affected users, the environmental committees and the airport users. The new design will be independently validated by checking they comply with ICAO and CAAs' regulation and that it can be flown when tested with specific software tools and flight simulators (partially covered by the Sourdine II project).
- Flight tests must be performed of all the procedures to check the navigational infrastructures' coverage, of the procedure and the obstacle evaluation.
- The publication of the new procedures must be clear and not give space to ambiguity. The State applying the procedures would also be in charge of checking the procedures are correctly uploaded/inserted in the commercial database, to insure its precision.

16 Dissemination of the procedures among the ANSPs, the users, etc. To make the information as clear and straightforward as possible, as emphasized in many occasions (PLANO Workshop, ANERS, Sourdine II Workshop, etc.): improved collaboration and awareness among the stakeholders is vital within and outside the industry.

7.2. The ECIP

The objectives and the implementation schedule of the ECIP was taken into account during the writing of this document.

The ECIP objectives provide the means to apply the ATM system changes needed to meet the performance target.

The ECIP 2005 –2009 contains 62 implementation objectives. These support different types of operational improvement in the European ATM system, and are spread over a number of ATM domains:

Many of these implementation objectives closely include the introduction of SII NAPs in the ATM system, either directly (ENV01 Basic CDA, 2008) or by delivering solutions (ATC06 Implement arrival management tools) to the constraints SII NAPs impose.

By taking the objectives date of implementation, a time schedule based on a concrete year could be produced, on the other hand it is preferred to give this flexibility to the decision maker, conscious of the situation of their ATM system and responsible for deciding the future steps.

8. Conclusions

The Sourdine II Departure procedures

The project has shown that the Sourdine II departure procedures are found to be currently implementable, while the arrivals should follow a stepped implementation.

The Sourdine II Arrival procedures in Step 1 (of the implementation cycle)

- Procedure II can be implemented in large airports
- Procedure V in medium airports
- Procedure III in small airports

Procedure IV should be further assessed for maintenance evaluation, feasibility and acceptance by the users.

The implementation has been divided into three main steps characterised by defining an iterative improvement cycle:

1. The stepped approach begins with the current situation by taking full advantage of existing technology.

2. The less intrusive procedures can be implemented in the short-term in a busy traffic ATM system.

3. The more intrusive procedures can be implemented in the short term in low density traffic.

The later (2) should be introduced in high density traffic once the challenges to define operational procedures that can be used by flight crew with no significant change in workload are solved and ways are found among all as to maintain minimum separation between aircraft resulting in keeping the airports' safety and capacity level.
Certain drawbacks on capacity and safety can be solved by attending the requirements the project highlighted for the near future..

Aspects not covered by the Implementation Plan

The aspect which has not been included into the implementation plan and of vital importance to the introduction of new procedures, is the dissemination phase. The projects outcome should be marketed and knowledge should be disseminated for two purposes:

1 Improve the knowledge on CDA based NAPs and

2 Show the public that efforts are made, changes and improvements can be achieved towards decreasing the environmental impact of the aviation industry.

Above all, this must be followed by improvements in all the other driving forces of the balanced approach.

Further steps not covered by the implementation document:

- Sourdine II procedures tailored to the local situation (i.e. departures)
- Uniform guidelines on CDA design and implementation need to be developed (already covered by Eurocontrol's Basic-CDA and the ECIP).
- Additional research is needed to fully exploit CDA with advanced ATC automation tools. The emergence of different local airport procedures raises the need for standardization.
- Technology improvements
- Communication among stake holders (partially covered during the project's workshops, presentations and brainstorms).

Appendix A Procedure Implementation Matrix